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Leigh et al.

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(54) **CONNECTOR INDICIA**

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G02B 6/38 (2006.01)

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(2013.01); **G02B 6/3851** (2013.01); **G02B 6/3885** (2013.01); **G02B 6/3897** (2013.01)

(58) **Field of Classification Search**
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G02B 6/4227; G02B 6/38; G02B 6/36;
G02B 6/3895; G02B 6/3879
USPC 385/71, 52, 53, 54, 55, 56, 59, 65, 77,
385/78, 83, 134

See application file for complete search history.

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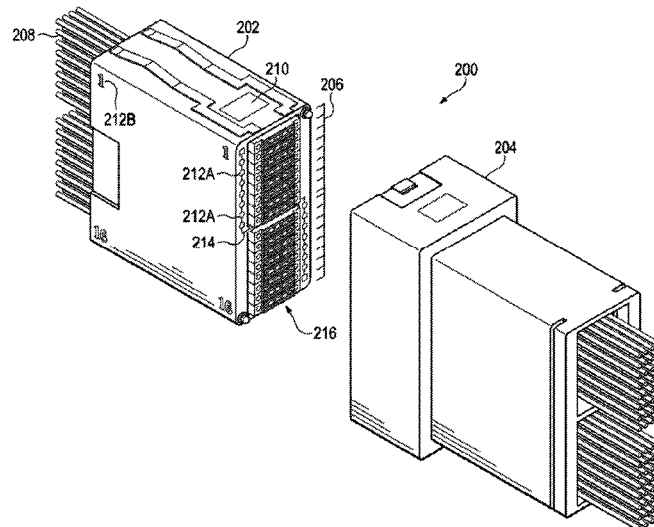
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(57) **ABSTRACT**

A plurality of connector modules is disclosed. The connector modules have respective various indicia including topside indicia to indicate orientation and ferrule indicia to indicate ferrule position. Ferrules may be removably inserted into the connector modules, and may include seated indicia that indicate if the ferrules are seated.

11 Claims, 5 Drawing Sheets



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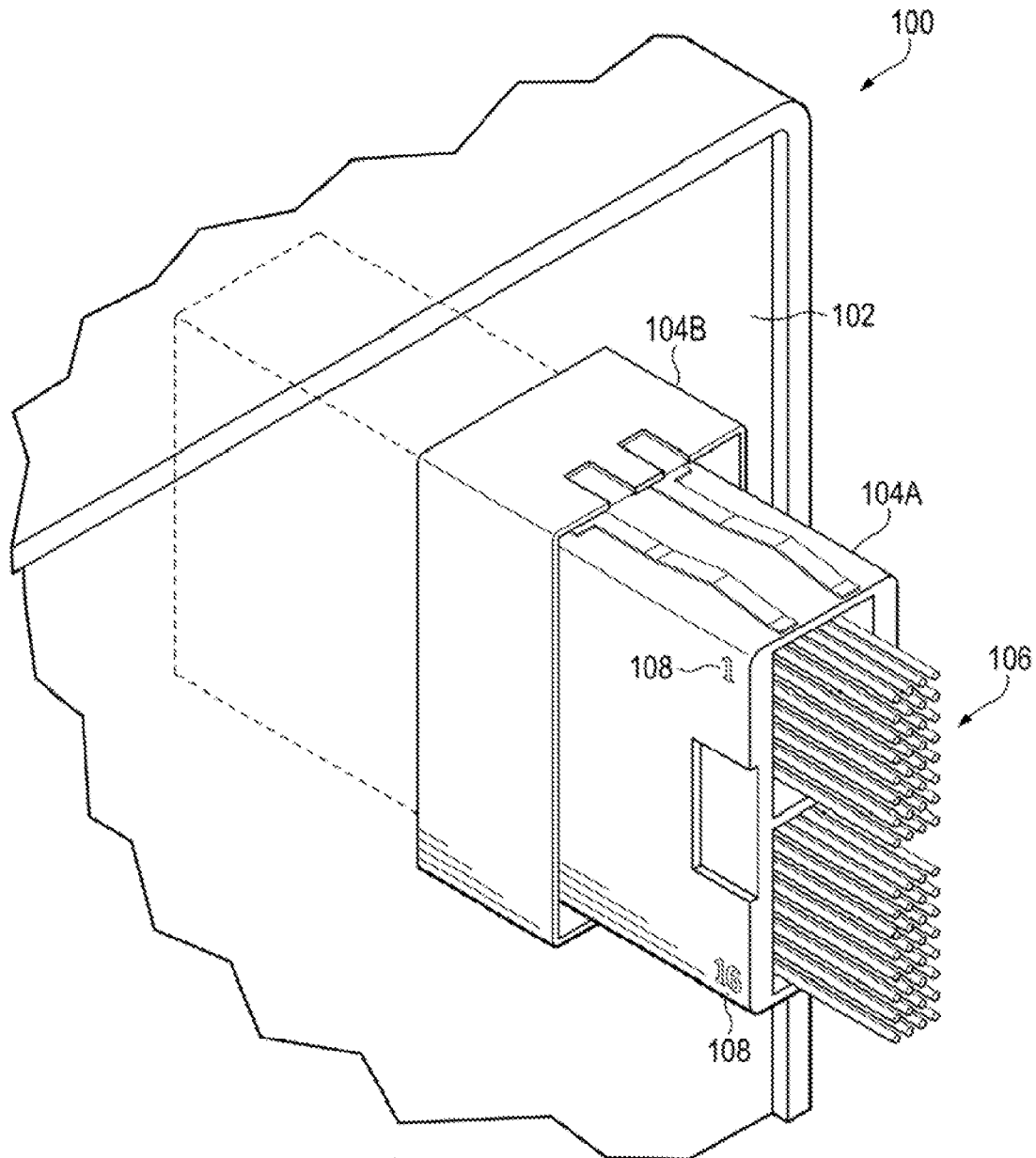
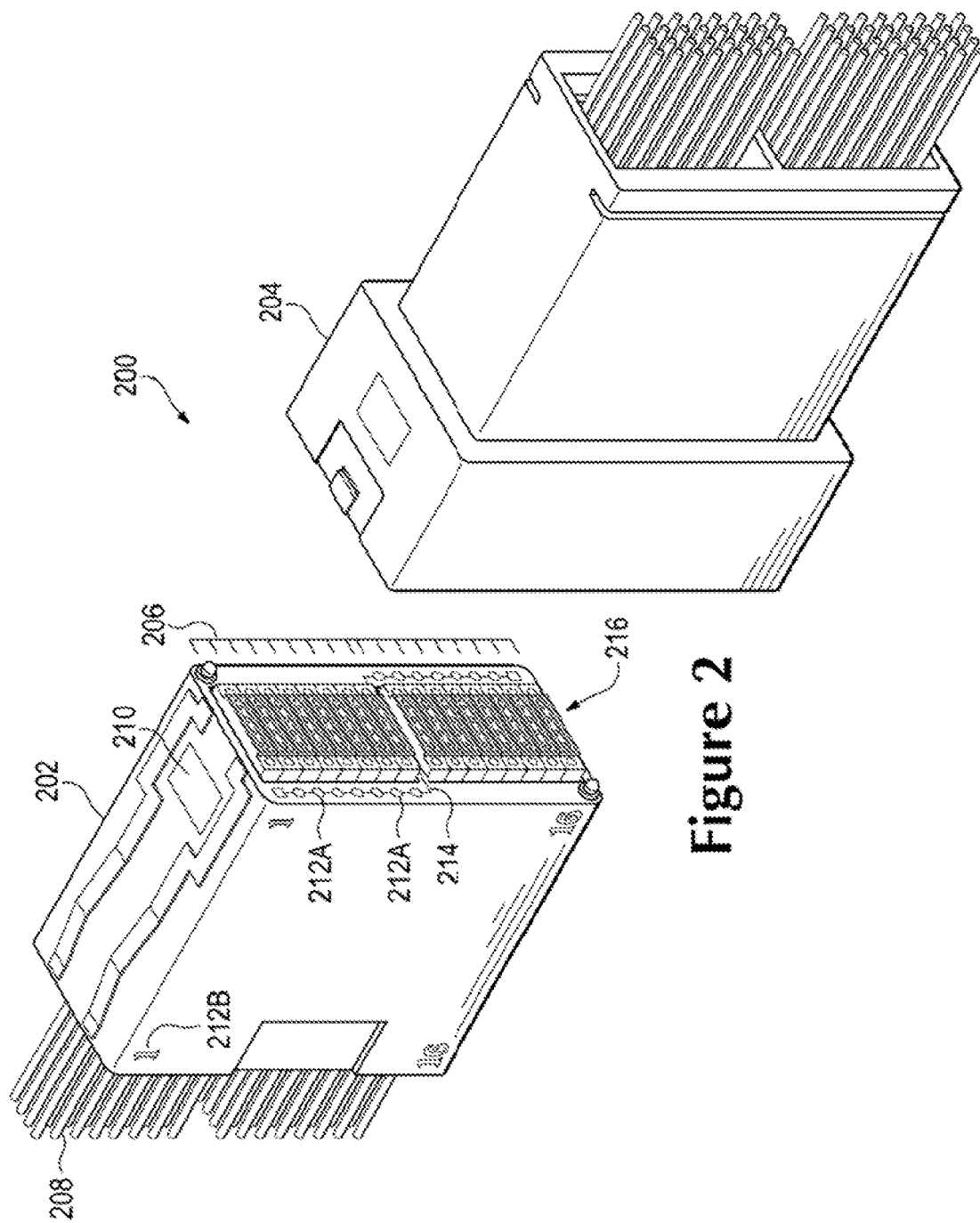


Figure 1



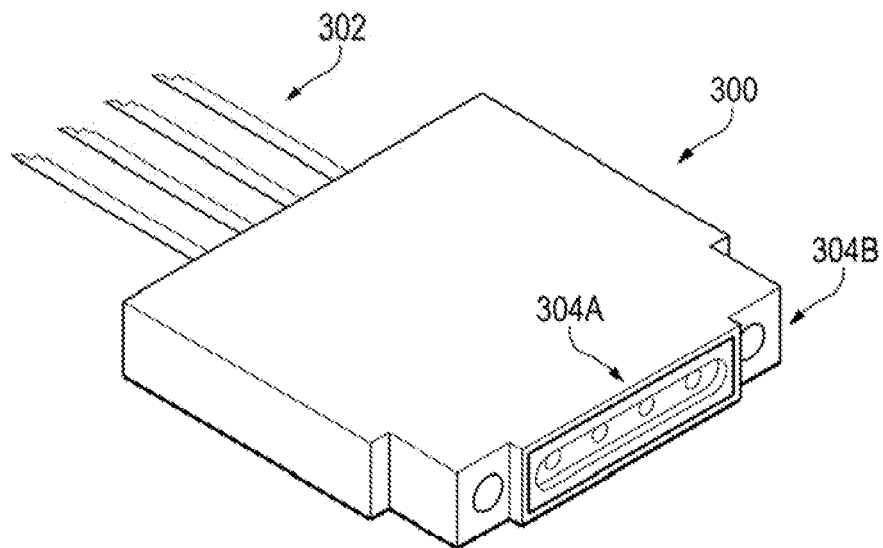


Figure 3A

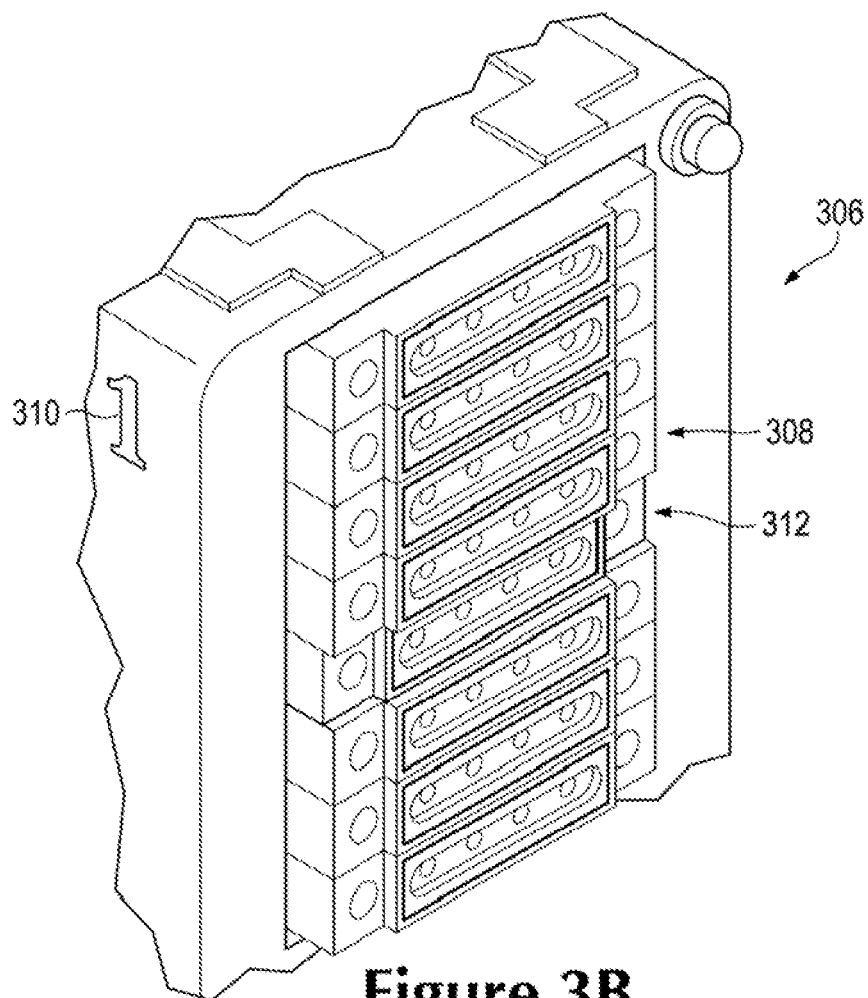


Figure 3B

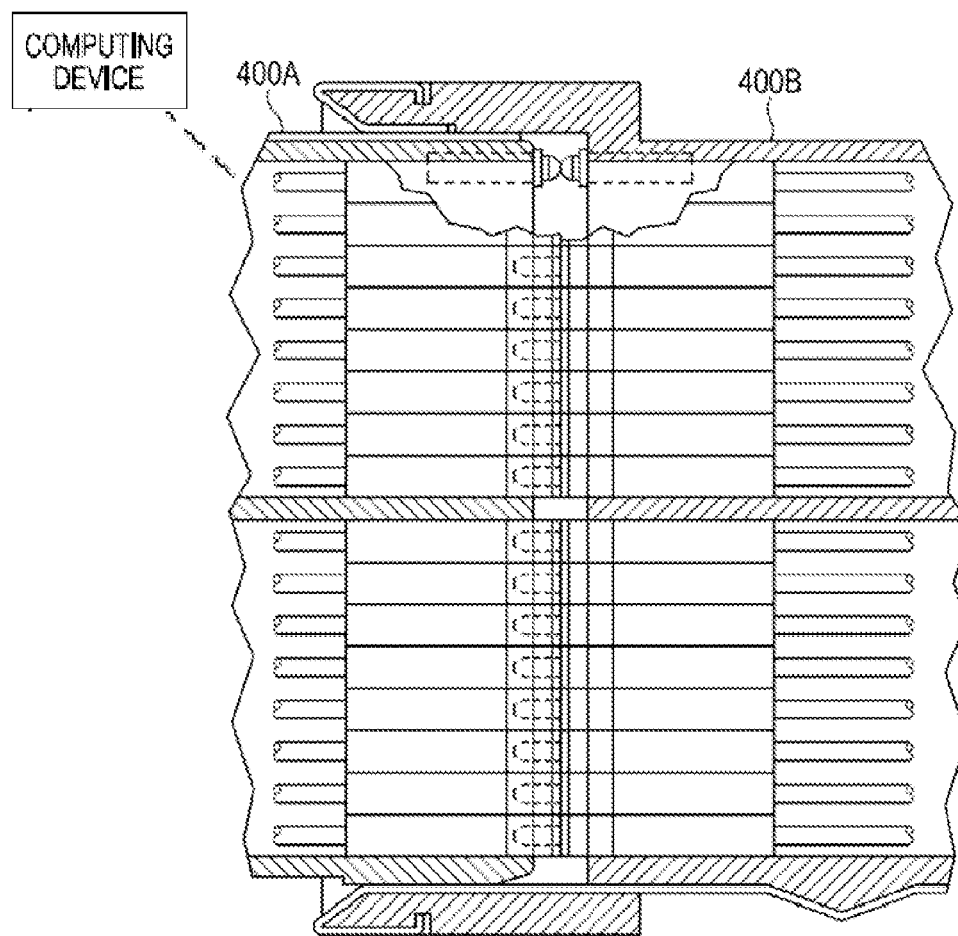


Figure 4

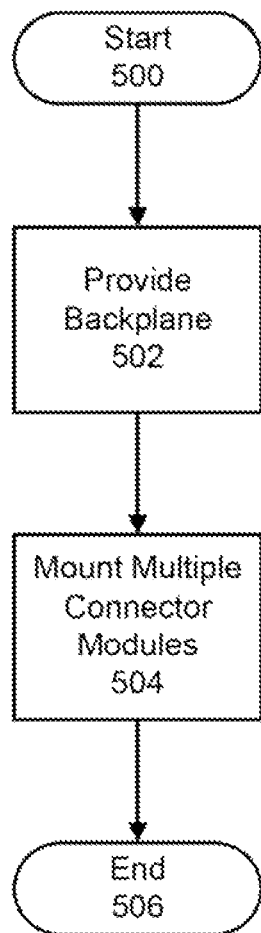


Figure 5

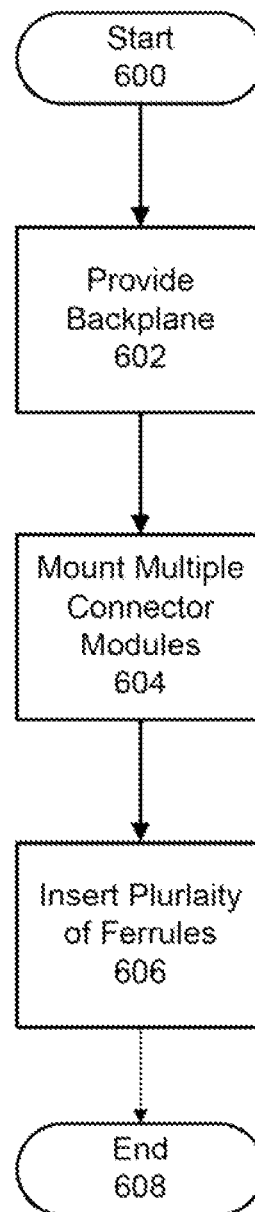


Figure 6

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CONNECTOR INDICIA

BACKGROUND

A system can include multiple electronic devices. To allow communication with the electronic devices, a backplane infrastructure can be provided in the system, where the backplane infrastructure has connectors to connect with respective mating connectors of the electronic devices. The connectors of the backplane infrastructure can include optical connectors to optically connect to respective electronic devices.

BRIEF DESCRIPTION OF THE DRAWINGS

Some examples are described with respect to the following figures:

FIG. 1 is a perspective view of a backplane including electronic device connectors according to some implementations;

FIG. 2 is a perspective view of a connector module according to some implementations;

FIG. 3A-B illustrate perspective views of a ferrule and a connector module according to some implementations;

FIG. 4 is a sectional view of a connector module according to various implementations;

FIGS. 5-6 are flow diagrams according to some implementations.

DETAILED DESCRIPTION

Electronic devices, such as processing devices, storage devices, communications devices, management devices, and so forth, can be mounted in a rack, which includes a frame and other support elements for holding the electronic devices. The rack provides receptacles into which the electronic devices can be inserted. The rack can also include a backplane infrastructure for connection to the electronic devices that have been inserted into the rack. When electronic devices mounted in the rack, connectors on the electronic devices can mate with connectors of the backplane infrastructure. The connectors of the backplane infrastructure are connected to communications media (e.g. optical fibers, electrical wires, etc.) to allow for communication among the electronic devices.

A backplane infrastructure can include optical connectors for optical connection with respective optical connectors of the electronic devices. It is noted that the electronic devices and the connector infrastructure can also include electrical connectors for electrically connecting the electronic devices to the backplane infrastructure. In the ensuing discussion, reference is made to just optical connectors—note, however, that various components discussed below can also include or be substituted with electrical connectors.

In some examples, a backplane infrastructure can include an integrated and fixed arrangement of optical connectors for connection to respective electronic devices. An integrated and fixed arrangement of optical connectors refers to an arrangement in which the optical connectors are affixed to a support structure of the backplane infrastructure such that the optical connectors have to be connected to or disconnected from all electronic devices in a system at the same time. These optical connectors may have multiple ferrules, where each ferrule organizes multiple optical fibers. Generally a ferrule of an optical connector refers to an interface for an optical fiber, where the interface allows for optical communication between the optical fiber and another optical component. The ferrules can be fixed within the optical connector or alternatively may be removably coupled to the optical connector.

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The ability to remove and replace various ferrules can present an issue when various ferrules are accessed for service (e.g. to repair of a component) or upgrade (e.g. to replace a component). For example, in a high density optical connector an operator may need to remove and replace multiple ferrules which have designated positions within the connector. The placement of a ferrule improperly may pose problems for the overall system. Additionally, placement of a ferrule into an optical connector such that is not properly seated may also lead to degradation of signals of the system. These problems, when presented to customers or technicians, may be diagnosed improperly leading to repair and/or replacement of costly and properly functioning components (e.g. replacement of an entire backplane).

In accordance with some implementations, a connector infrastructure is provided that has various indicia to enable operators and computing devices to install, reconfigure, and detect issues related to placement of multiple ferrules within an optical connector. “Indicia” as used herein is defined as any distinctive marking, sign, or indication. Examples of indicia may be numbers, symbols, shapes, or textures, among others. The indicia may be affixed to various components and/or integrated with the components (e.g., engraved). In various examples, indicia provided with the connector infrastructure may enable an operator to quickly and properly configure multiple ferrules within a connector, enable a diagnostic computing device to locate and identify specific ferrules (e.g., a damaged, clean, or improperly seated), or enable computing devices to convey relative positions so that additional operations may be done efficiently.

In addition to a connector infrastructure including indicia, in various examples of the present disclosure, a ferrule may also include indicia. Ferrule indicia may enable operators or computing devices (e.g. diagnostic computing devices) to determine whether a ferrule is “seated” within the connector infrastructure. A ferrule is seated within the connector infrastructure when the ferrule enables a fiber optic cable to communicate with an intended component within the mating connector. In this manner, diagnostic computing devices when inserted into a rack, may be enabled to quickly, efficiently, and correctly identify whether various ferrules are properly seated, and in response to an indication that a ferrule is not seated properly, utilize combinations of indicia to convey a relative location of the ferrule.

FIG. 1 illustrates an example system 100 that has a backplane infrastructure 102 that includes a connector 104A-B. The backplane infrastructure 102 and connector module having a first housing 104A and a second housing 104B that are configured to mate. The mating may couple various electronic devices (not illustrated) that are inserted into receptacles disposed on a chassis housing the backplane infrastructure 102 to each other and to other devices. The electronic devices may be configured to blind-mate with the backplane infrastructure 102. The connector modules 104A-B, as illustrated, are optical connectors that include multiple ferrules that organize optical fibers 106. In the illustration, sixteen ferrules are utilized, each ferrule organizing four optical fibers 106. More or fewer ferrules which may organize more or fewer optical fibers may also be used. In addition, the connector modules 104A-B include indicia 108. Indicia 108 may be disposed in various locations of one or both of connector modules 104A-B.

FIG. 2 shows a optical connector 200 that has a support frame 202 for connection to a mating support frame 204 of a respective electronic device (e.g. 104 in FIG. 1). A support frame 202 is defined as a structure configured to couple to another optical connector that supports one or more other

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components. Support frame **202** may also be referred to as a housing. The optical connector **200** further has a plurality of ferrules **206** organizing optical fibers **208** removably coupled to the support frame **202**. Although sixteen ferrules are illustrated in FIG. 2, note that there can be different numbers of ferrules **206**, each ferrule including different numbers of fiber optic cables **208**. Moreover, the optical connector **200** can also include various lenses and other optical components to allow for optical communications.

As further shown in FIG. 2, the connector module **200** includes topside indicia **210** to indicate orientation of the support frame **202** and a plurality of ferrule indicia **212A-B** to indicate a plurality of ferrule positions for ferrules **206**. In various examples, indicating a topside of the support frame **202** may ensure proper installation with both various electronic devices and various back-planes, while indicating plurality of ferrule positions may enable or facilitate proper installation of various ferrules **208**. For example, upon insertion of a ferrule **206** into the support frame **202**, a number for the ferrule may be noted. Upon replacement or upgrade of the particular ferrule **206**, a user or computing device may be able to quickly and correctly place the corresponding ferrule **206** back into an appropriate position.

The topside indicia **210** and ferrule indicia **212A-B** may be disposed in various areas of the support frame **202**. For example, ferrule indicia **212A** may comprise a plurality of symbols disposed on a front face of the support structure **202** (as illustrated). The symbols may be unique for each ferrule position, or alternatively, may comprise a first symbol corresponding to a first position (square) and a second symbol corresponding to the remaining positions (circles). This may enable a computing device to locate a first position (e.g., the unique ferrule indicia) and iteratively inspect remaining positions. In addition, the plurality of ferrule indicia may comprise direction indicia **214** that indicates a location of a next ferrule **206**. Again, such indicia may facilitate identification of respective locations to users, operators, and/or various computing devices. In yet another example, ferrule indicia **212B** may comprise a plurality of numerals or letters disposed on a side of support frame **202**. Other examples and indicia are contemplated.

As further depicted in FIG. 2, the plurality of ferrules **206** may be removably coupled to the support frame **202** and comprise seated indicia **216**. The seated indicia **216**, which is illustrated more clearly in other figures to be discussed herein, is configured to indicate whether the plurality of ferrules **206** are seated in the plurality of ferrule positions. As mentioned previously, a ferrule **206** is seated within the support frame **202** when the ferrule **205** enables a fiber optic cables **208** to communicate with an intended component coupled to mating connector **204**.

In various examples, seated indicia **216** may comprise a chamfered edge, such that when viewed with respect to other ferrules **206** or a support frame **202**, a relative determination of a particular ferrule's seating can be made. Other types of seated indicia **216** may include contrasting colors, such as black and white. In one example, such seated indicia **216** enables a recorder device, such as diagnostic electronic device with a camera, to associate the relative positions of a ferrule **206** in the support frame **202** and the condition of the ferrule **206** and optical fiber **208**.

FIG. 3A depicts a singular view of a ferrule **300**. The ferrule **300**, as illustrated, organizes four optical fibers **302**. As stated previously, more or fewer optical fibers may be coupled to ferrule **300**. Ferrule **300** includes seated indicia **304A-B**. Seated indicia **304A** comprise an outline or contrasting color with respect to the ferrule **300** such that a visual

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inspection by a user or diagnostic device, may be able to determine an improper seated condition relative to other ferrules. Seated indicia **304B** includes a stepped edge as described with reference to FIG. 2. Alternatively, a ferrule **300** may include other seated indicia such as, but not limited to, a chamfered edge (not illustrated) along one or more edges of ferrule **300**.

FIG. 3B depicts a connector module **306** generally similar to that of FIG. 2 and including a plurality of ferrules **308** as illustrated in FIG. 3A. Within the connector module **306** are disposed a plurality of removable ferrules **308**. Each of the plurality of ferrules **308** is coupled to multiple fiber optic cables as illustrated in FIG. 3A. The plurality of ferrules **308** include seated indicia **304A-B** configured to indicate whether the plurality of ferrules **308** are seated in the plurality of ferrule positions indicated by ferrule indicia **310**.

In the illustrated example, the plurality of ferrules **308** include an improperly seated ferrule **312**. When connector module **306** is coupled with a mating connector (not illustrated), communication transmitted via optical fibers organized by ferrule **312** may experience degradation. In response to lost or degraded data or in response to an inspection, various computing devices or users may first inspect the seated indicia **304A-B** and determine that ferrule **312** was inadvertently not seated.

In the illustrated example, the seated indicia **304A-B** comprises one or more steps **304B**, and contrasting colors **304A** on the plurality of ferrules **308**. The plurality of steps **304B** when properly aligned may form a consistent edge. When seated improperly, as illustrated, the plurality of ferrules **302** and their seated indicia **304B** may form an inconsistent edge such as to visually indicate to a user or diagnostic computing device an improper seated condition. In addition, when seated improperly, as illustrated, seated indicia **304A** also form an inconsistent appearance relative to other ferrules.

In FIG. 4, the connector module **400A** is illustrated as being mated with the mating connector **400B**. In the mated position, the plurality of ferrules of the connector module **400A** are communicatively coupled to the plurality of ferrules of the mating connector **400B** such that data may be transmitted through the multiple ferrules and consequently to various electronic devices within the rack.

In one example, an electronic device coupled to the connector module **400A** may be a diagnostic computing device (not illustrated). A diagnostic computing device may be inserted into the rack and coupled to a connector module **400A** of the rack in order to inspect various components and connectivity among various devices, such as the mating connector **400B**. The diagnostic computing device may utilize the plurality of ferrule indicia and the seated indicia to diagnose the connector module **400B**.

FIGS. 5-6 are flow diagrams of processes of assembling an apparatus or system as discussed above according to some implementations. The processes of FIGS. 5 and 6 can be performed at a manufacturing facility of the connector module **108**.

The process of FIG. 5 provides (at **502**) a backplane. The process then mounts (at **504**) multiple connector modules (e.g. **200** in FIG. 2) to the backplane, wherein the connector modules include topside indicia to indicate an orientation of the connector module and a plurality of ferrule indicia to indicate a plurality of ferrule positions within the connector module.

The process of FIG. 6, provides (at **602**) a backplane. The process then mounts (at **604**) multiple connector modules (e.g. **200** in FIG. 2) to the backplane, wherein the connector modules include topside indicia to indicate an orientation of

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the connector module and a plurality of ferrule indicia to indicate a plurality of ferrule positions within the connector module. The process then inserts (at 606) a plurality of ferrules into the connector module, wherein the plurality of ferrules include seated indicia. In various examples, the plurality of ferrules are inserted into the connector module according to the ferrule indicia.

In the foregoing description, numerous details are set forth to provide an understanding of the subject disclosed herein. However, implementations may be practiced without some or all of these details. Other implementations may include modifications and variations from the details discussed above. It is intended that the appended claims cover such modifications and variations.

What is claimed is:

1. A system, comprising:

a connector, comprising:

a support frame comprising a topside indicia to indicate an orientation of the support frame and a plurality of ferrule indicia to indicate a plurality of ferrule positions,

wherein the plurality of ferrule indicia comprises a unique symbol for each ferrule position; and

a plurality of ferrules removably coupled to the support frame, wherein each of the plurality of ferrules comprise a seated indicia configured to indicate whether the plurality of ferrules are seated in the plurality of ferrule positions; and

a computing device coupled to the connector to determine a location of one of the plurality of ferrules in response to an indication that the one of the plurality of ferrules is not seated properly.

2. The connector of claim 1, wherein the plurality of ferrule indicia comprise a plurality of numbers.

3. The connector of claim 1, wherein the plurality of ferrule indicia further comprise a direction indicia to indicate a location of a next ferrule of the plurality of ferrules.

4. The connector of claim 1, wherein the plurality of ferrules are correspondingly coupled to a plurality of optical fibers.

5. The connector of claim 1, wherein the support frame and the plurality of ferrules are removably coupled to an optical connector.

6. A system comprising:

a connector module comprising:

a support frame comprising a topside indicia to indicate an orientation of the support frame and a plurality of ferrule indicia to indicate a plurality of ferrule positions,

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wherein the plurality of ferrule indicia comprises a unique symbol for each ferrule position; and

a plurality of ferrules removably coupled to the support frame, wherein each of the plurality of ferrules comprise a seated indicia configured to indicate that the plurality of ferrules are seated in the plurality of ferrule positions; and

a mating connector coupled to the connector module, the mating connector comprising:

another plurality of ferrules corresponding to the plurality of ferrules of the connector module, wherein the another plurality of ferrules are communicatively coupled to the plurality of ferrules of the connector module when the plurality of ferrules are seated in the plurality of ferrule positions; and

a computing device coupled to the connector module to determine a location of one of the plurality of ferrules in response to an indication that the one of the plurality of ferrules is not seated properly.

7. The system of claim 6, wherein the plurality of ferrule indicia comprise a plurality of numbers.

8. The system of claim 6, wherein the plurality of ferrule indicia further comprise a direction indicia to indicate a location of a next ferrule of the plurality of ferrules.

9. The system of claim 6, wherein the computing device is a diagnostic computing device to utilize the plurality of ferrule indicia and the seated indicia to diagnose the connector module.

10. A method of assembling a connector, comprising:

providing a backplane; and

mounting a plurality of connector modules to the backplane, wherein the connector modules include topside indicia to indicate an orientation of the connector module and a plurality of ferrule indicia to indicate a plurality of ferrule positions within the connector module, wherein the plurality of ferrule indicia comprises a unique symbol for each ferrule position;

inserting a plurality of ferrules into the connector module, wherein the plurality of ferrules are removable and include seated indicia; and

coupling a computing device to the plurality of connector modules, the computing device to determine one of the plurality of ferrule positions in response to an indication that a ferrule associated with the one of the plurality of ferrule positions is not seated properly.

11. The method of claim 10, wherein the plurality of ferrules are inserted into the connector module according to the ferrule indicia.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,223,097 B2
APPLICATION NO. : 14/362959
DATED : December 29, 2015
INVENTOR(S) : Kevin B. Leigh et al.


Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Drawings

In sheet 5 of 5, reference numeral 606, line 1, delete "Plurlaity" and insert -- Plurality --, therefor.

Signed and Sealed this
Seventh Day of June, 2016

A handwritten signature in black ink, reading "Michelle K. Lee". The signature is written in a cursive style with a large, stylized "M" and "L".

Michelle K. Lee
Director of the United States Patent and Trademark Office